TITAN

2000W Electric Chainsaw

Manufacturing, Materials and Costs
ME30365: Reverse Engineering

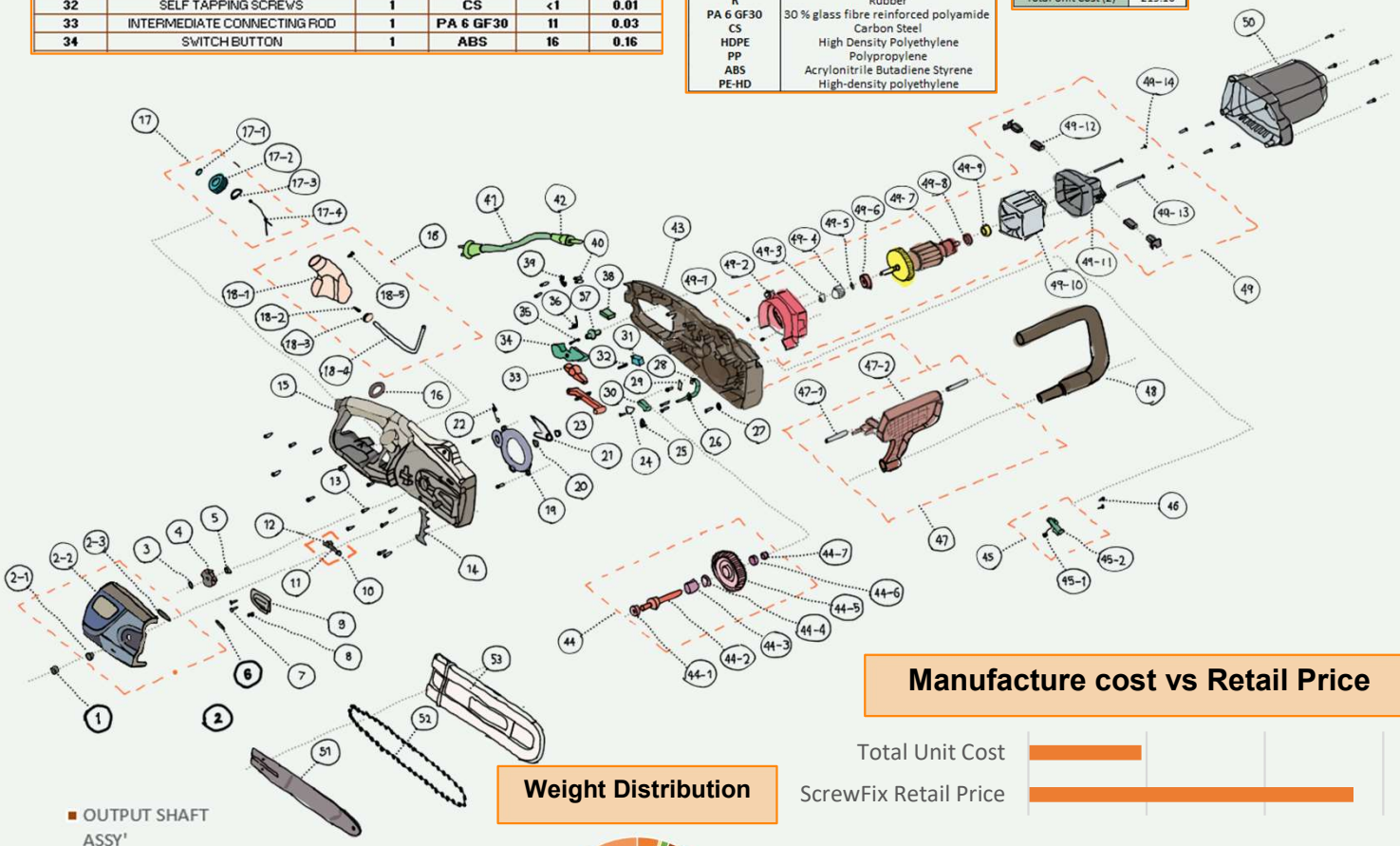
Oliver Allin

Estimated Bill of Materials

Part No.	Part Description	Qty.	Material	Mass (g)	Cost (£)
1	HEXAGON NUTS WITH FLANGE	1	SS	6	0.01
2	THE END CAP ASSEMBLY	1		130	0.49
2-1	SPINDLE COVER	1	SS	-	-
2-2	THE END CAP	1	PA 6 GF30	-	-
2-3	SEAL RING	1	R	-	-
3	SPLIT WASHER	1	CS	<1	0.01
4	CHAIN WHEEL	1	CS	27	0.21
5	TENSIONING SPRING	1	CS	<1	0.1
6	SEAL RING	1	R	<1	0.02
7	PHILIPS PANHEAD SCREW - M4x10	2	CS	<1	0.12
8	SELF TAPPING SCREWS	1	CS	<1	0.01
9	HEAT INSULATION WASHER	1	SS	21	0.01
10	ADJUSTING SCREW ROD	1	CS	7	0.19
11	FLAT WASHER	1	CS	<1	0.01
12	TIGHTENING NUT	1	CS	7	0.1
13	SELF TAPPING SCREWS	13	SS	17	0.13
14	DEAD BLOCK	1	SS	23	0.21
15	RIGHT HOUSING	1	PA 6 GF30	428	1.34
16	RUBBER BLANKET	1	R	<1	0.02
17	OIL BOX CAP ASSY		STOCK	13	0.49
17-1	CAP COVER	1	-	-	-
17-2	OIL BOX CAP	1	-	-	-
17-3	SEAL RING	1	R	-	-
17-4	HANGER	1	-	-	-
18	OIL BOX ASSY			45	0.99
18-1	OIL BOX	1	HDPE	-	-
18-2	FILTER SPRING	1	CS	-	-
18-3	OIL BOX SEAL RING	1	R	-	-
18-4	TRANSPARENT OIL TUBE	1	-	-	-
18-5	VALVE	1	-	-	-
19	DUST SHIELD	1	PA 6 GF30	23	0.07
20	SPINDLE COVER	1	CS	3	0.02
21	BRAKE PAD	1	CS	28	0.02
22	BRAKE RETRACTING SPRING	1	CS	<1	0.19
23	LINK SWITCH	1	PA 6 GF30	13	0.04
24	CLAMP	1	CS	<1	0.04
25	BRAKE LEVER SPRING	1	CS	<1	0.19
26	NOZZLE COMPONENTS	1	-	17	0.24
27	BRAKE LINING	1	SS	3	0.49
28	TRANSPARENT OIL TUBE	1	-	3	0.92
29	CLAMP	1	SS	7	0.06
30	PROTECTION PLATE LOCATION BLOCK	1	PA 6 GF30	3	0.01
31	MICROSWITCH	1	-	14	0.39
32	SELF TAPPING SCREWS	1	CS	<1	0.01
33	INTERMEDIATE CONNECTING ROD	1	PA 6 GF30	11	0.03
34	SWITCH BUTTON	1	ABS	16	0.16
35	SWITCH TORSIONAL SPRING	1	CS	<1	0.14
36	BUTTON TORSIONAL SPRING	1	CS	<1	0.39
37	LOCK OFF BUTTON	1	ABS	4	0.01
38	TWO FEET CAPACITANCE	1	-	13	0.24
39	CABLE BOARD	1	-	10	0.49
40	TERMINAL STRIP	1	-	13	0.15
41	POWER CORD	1	-	383	1.2
42	CABLE SHEATH	1	-		0.84
43	LEFT HOUSING	1	PA 6 GF30	482	1.51
44	OUTPUT SHAFT ASSY'		STOCK	268	0.99
44-1	6900 BEARING	1	-	-	-
44-2	OUTPUT SHAFT	1	-	-	-
44-3	TORSIONAL SPRING	1	-	-	-
44-4	SPINDLE COVER	1	-	-	-
44-5	OUTPUT SHAFT GEAR	1	-	-	-
44-6	608Z BEARING	1	-	-	-
44-7	HEXAGON LOCK NUT	1	-	-	-
45	OIL PUMP ASSEMBLY		STOCK		0.49
45-1	OIL PUMP TENSION SPRING	1	-	-	-
45-2	OIL PUMP	1	-	-	-
46	PHILIPS PANHEAD SCREW	2	-	-	-
47	PROTECTIVE PLATE ASSEMBLY			174	0.89
47-1	CLUMP WEIGHT	1	SS	-	-
47-2	PROTECTIVE PLATE	1	PP	-	-
48	FRONT HANDLE	1	PP	211	-
49	MOTOR ASSEMBLY		STOCK		3.49
49-1	TYPE 1 NON - METAL INSERT HEXAGON LOCK NUT	-	-	<1	-
49-2	WIND SCREEN	-	-	-	-
49-3	HEXAGON NUTS WITH FLANGE	-	-	742	-
49-4	MOTOR GEAR	-	-		-
49-5	MOTOR GEAR BUSHING	-	-		-
49-6	BEASRING	-	-		-
49-7	THE ROTOR ASSEMBLY	-	-		-
49-8	608Z BEARING	-	-		-
49-9	BEARING SLEEVE	-	-		-
49-10	STATOR	-	-	1032	-
49-11	MOTOR BACK SUPPORT	-	-		-
49-12	BRUSH HOLDER ASSEMBLY	-	-		-
49-13	THE STATOR SCREW	-	-		-
49-14	COMPOUND SLOTTED SCREW	-	-		-
50	MOTOR REAR COVER	1	PP	164	0.08
51	GUIDE BAR	1	SS	522	0.31
52	OREGON CHAIN	1	CS	178	0.1
53	GUIDE BAR SLEEVE	1	PE-HD	129	0.49

Materials Key	
SS	Stainless Steel
R	Rubber
PA 6 GF30	30 % glass fibre reinforced polyamide
CS	Carbon Steel
HDPE	High Density Polyethylene
PP	Polypropylene
ABS	Acrylonitrile Butadiene Styrene
PE-HD	High-density polyethylene

Total Weight (kg)	5.19kg
Total Unit Cost (£)	£19.16



Weight Distribution

Manufacture cost vs Retail Price

Cost Summary Assumptions:

- Prices estimated from per 100 units
- Costs taken from Alibaba, RS components and other manufacturers
- Some cost estimates based off retail prices (Adjusted)

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Casing Deep Dive

- The casing is split into two parts both moulded separately.
- Bother parts are made from PA6 GF30 which is a high-performance engineering plastic
- Selected for its strength, durability and heat resistance.
- Due to the 30% fibre glass content of the material, the part warps less

Ribs

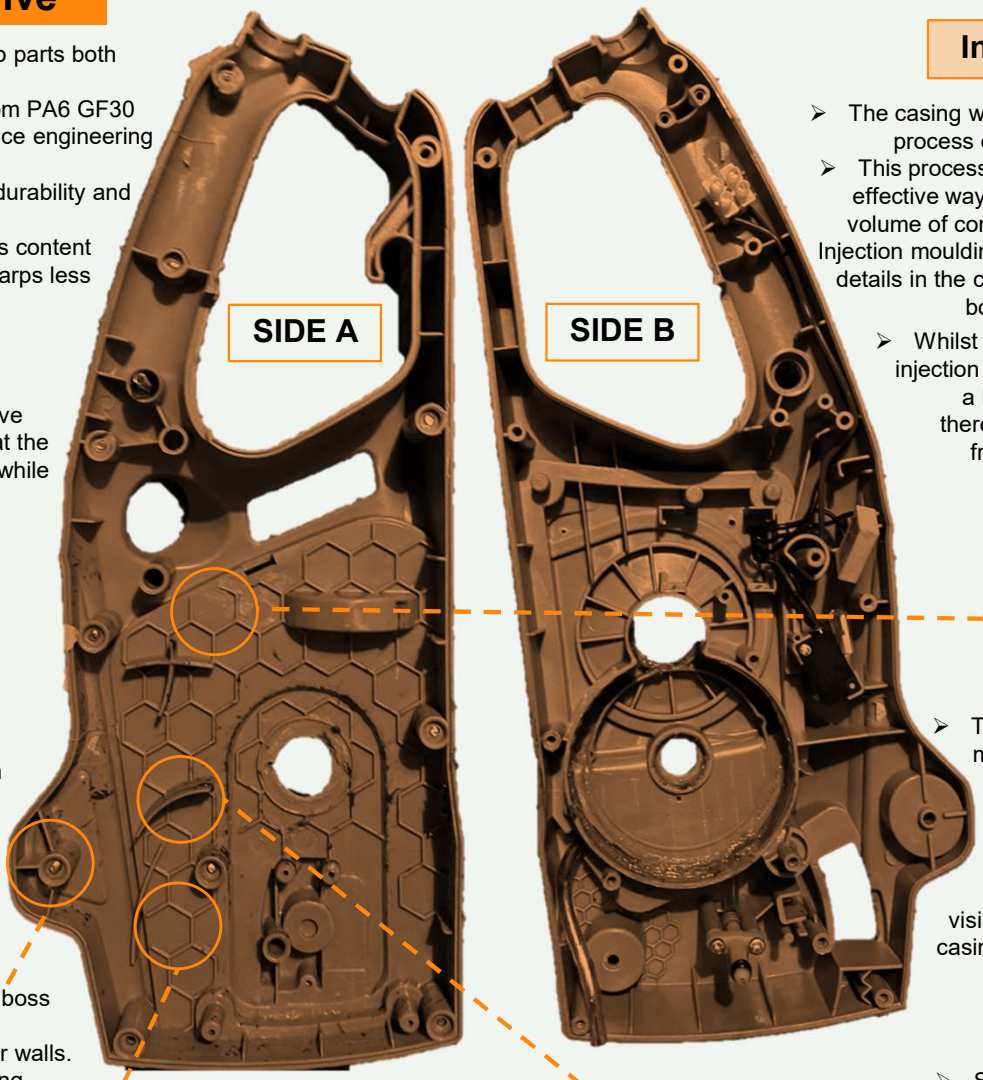
- Rather than filling in empty spaces with material, to save costs ribs are added so that the part maintains its strength while reducing its mass.

Reinforces bolt bosses

- The Chainsaws Moulded Casing contains 38 bosses used to secure the two halves of the case together.
- The reinforcing of these bosses varies depending on location and requirement
- It is recommended that the thickness of a boss wall should be between 40 and 60 percent of the thickness of the wall from which the boss rises.
- In addition to having a thick boss wall, some also have ribs connecting them to the outer walls. These are on the load bearing bosses such as the handle boss.

Honeycomb Ribs

- The honeycomb pattern created on the walls of the part is to prevent warping of the part wall.
- It is a cheaper alternative to thickening the wall itself.



Injection Mould

- The casing was made through the process of injection moulding.
- This process is chosen as it is an effective way for producing a high volume of consistent design parts. Injection moulding allows for the high details in the casting from the small bosses to the hex ribs.
- Whilst it is a cheap process injection moulding does have a high tooling cost and therefor doesn't allow for frequent/minor design changes.

- The process of injection moulding leaves ejector pin markings on the part.
- This isn't a worry for the designer of the chainsaw as these are visible on the inside of the casing which the consumer wouldn't see.

Alignment

- Side A of the mouldings has an aligning ridge going around the entire outline of the casing.
- Adding this ensures that all the bosses line up when the two parts are joined.

Mold information

- Being an injection mould also allows for small details to be added.
- Such as the date and time the part was made, in addition to the material that it is made of.

Guide Bars

- The designer has used the detailed nature of moulding to create guide bars to steer other parts.
- For example, guiding the chain brake link so that it can easily engage/disengage.

Improvements

Another improvement to the casing of the product could be to replace the material. By swapping to Long glass fibre reinforced nylon6 (PA6 LGF30) instead of the PA6 GF30 would increase the strength of the product and decrease the price of its production.

Part of the moulded casing goes unused; this is probably due to a design change, but the designer decided to not change the tooling.
This excess material cost can be removed by a redesign on the tooling removing this additional material.
There will be a high initial cost as it would be a redesign of the tooling however it would be justifiable as the change is a large enough to impact the material cost.

Another improvement that I would recommend would be to add a reinforcing plate to spread the load to the tensioning bolt. This can be done by extending the heat insulation washer. From reviews many individuals state that the metal bolt deforms the plastic over time, and it becomes unusable.

References:
- https://kingfisherspares.com/product/TTL758CHN
- https://www.protolabs.com/resources/design-tips/plastic-boss-design-on-molded-parts
- https://www.lfrt-plastic.com/info/why-choose-pa6-lgf30-material-to-replace-pa66g-84988461.html